Emission Calculation Fact Sheet

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ELECTROPLATING OPERATIONS

This document lists Source Classification Codes (SCC) and emission factors for electroplating operations. They are provided as an aid in calculating emissions. The emission factors were obtained from the Factor Information Retrieval (FIRE) Data System, Version 6.23 and 6.24 or the Environmental Protection Agency's (EPA) *Compilation of Air Pollutant Emission Factors (AP-42).* Both are available on the Internet at **www.epa.gov/ttn/chief/index.html**.

It is not required that facilities use these listed factors to quantify their emissions. If a facility disagrees with any emission factor in this document, it may use other emission factors or another method of calculating emissions providing the emission factor or method correctly characterizes the processes at the facility and the resulting emissions. A facility doing so must submit calculations and documentation showing the source of the factors or method used and justification for their use.

Control factors
The listed emission factors are for uncontrolled emissions. If a facility has control equipment, such as a fabric filter, the emissions can be multiplied by the control factor. Calculate the control factor by subtracting the % control efficiency from 100 and then divide that number by 100. For example, if the control efficiency is 87%, the control factor would be (100 - 87)/100 = 0.13. Control efficiencies may be listed on the equipment or in the equipment documentation. Alternatively, equipment suppliers can provide control efficiency values.

Scientific notation
The emission factors are expressed in scientific notation, which means that the decimal point has been moved. If the exponent is negative, move the decimal point to the left. If the exponent is positive, move the decimal point to the right. If the exponent is zero, the decimal point does not move. For example, if a number is expressed as 2.0E-1, move the decimal point one place to the left to get 0.20. If a number is expressed as 2.0E2, move the decimal point 2 places to the right to get 200. If a number is expressed as 2.0E0, the decimal point does not move – the number is 2.0. A number expressed as E3 is 1,000.

SCC	DESCRIPTION	POLLUTANT	EMISSION FACTORS
3-09-010-01	Electroplating Operations Entire Process: General	NOX VOC	9.0E-3 LB/FT2 PLATED ITEM 2.6E-2 LB/FT2 PLATED ITEM
3-09-010-18	Electroplating Operations – Hard Chromium – Electroplating Tank	CHROMIUM VI PM10,PRIMARY	1.71E-2 LB/E3AMP-HR ELECT ENERGY 3.57E-2 LB/E3AMP-HR ELECT ENERGY
3-09-010-28	Electroplating Operations – Decorative Chromium – Electroplating Tank	CHROMIUM VI PM10,PRIMARY	4.714E-3 LB/E3AMP-HR ELECT ENERGY 9.857E-3 LB/E3AMP-HR ELECT ENERGY
3-09-010-38	Electroplating Operations – Chromic Acid Anodizing – Anodizing Tank	CHROMIUM VI PM10,PRIMARY	2.857E-1 LB/KFT2-HR EXPOSED AREA 6.0E-1 LB/KFT2-HR EXPOSED AREA

Note: CHROMIUM VI emissions may be reported to MAERS; however, they are not required to be reported.

LB/FT2 = pounds per square foot
LB/E3AMP-HR = pounds per 1000 ampere hours
LB/KFT2-HR = pounds per 1000 square foot hours

Sample Calculation

For a hard chromium electroplating operation that used 200,000 amp-hrs in a year, the emissions would be as follow:

CHROMIUM VI: 200 E3AMP-HR x 0.0171 LB/E3 AMP-HR = 3.42 LB CHROMIUM VI
(report toxic pollutants in pounds)

PM10,PRIMARY: 200 E3AMP-HR x 0.0357 LB/E3AMP-HR = 7.14 LB PM10,PRIMARY

There are other SCCs for electroplating; however, there are no emission factors associated with these SCCs. These SCCs include:

3-09-010-02	Electroplating Operations—Entire Process:	General (amperes per hour)
3-09-010-03	Electroplating Operations—Entire Process:	Nickel (square feet of tank surface area)
3-09-010-04	Electroplating Operations—Entire Process:	Copper (square feet of tank surface area)
3-09-010-05	Electroplating Operations—Entire Process:	Zinc (amperes per hour)
3-09-010-06	Electroplating Operations—Entire Process:	Chrome (amperes per hour)
3-09-010-07	Electroplating Operations—Entire Process:	Cadmium (amperes per hour)

Below is an equation that can be used to calculate emissions from electroplating operations. This equation can be used to calculate emissions from acid tanks and from electroplating tanks other than chrome. This equation was obtained from *Estimating Releases and Waste Treatment Efficiencies for the Toxic Chemical Release Inventory Form*, EPA-560/4-888-002.

$$W\ (lb/hr) = \frac{M\ (lb/lb\text{-}mole) \times A\ (ft^2) \times P\ (psia\ @\ T_1) \times K\ (ft/sec) \times 3600\ (sec/hr)}{R\ (psia\ ft^3/{}^oR\ lb\text{-}mole) \times T1\ ({}^oR)}$$

Where:
- W = emission rate
- M* = molecular weight of compound
- A = area of tank
- P** = vapor pressure of compound in solution
- K* = gas-mass transfer coefficient = $0.011479 \times U^{0.78} / M^{(1/3)}$
- U = wind speed in miles per hour (assume 1 mile/hr)
- R = gas constant = 10.73
- T_1 = absolute temperature of solution ($^oR = {}^oF + 460$)

* Here are the molecular weights and gas-mass transfer coefficients for compounds commonly used in acid tanks.

Compound	M	K
HCl	36.461	0.003465
H_3PO_4	97.9951	0.002494
HNO_3	63.013	0.002889
H_2SO_4	98.073	0.002493

** Look up vapor pressure in tables (available in *Perry's Chemical Engineers' Handbook*)

Sample Calculation

To calculate HCL emissions from an HCL acid tank:

Given: Temperature of acid tank = 95°F (35°C)
Concentration of HCL Solution = 10%
Dimensions of acid tank = 3 ft by 4 ft
Molecular weight of HCL = 36.461 lb/lb-mole (see previous table)

Solution:

1. Determine area (A) of acid tank.
   3 ft x 4 ft = $12ft^2$

2. Determine vapor pressure (P)

   According to Perry's Chemical Engineers' Handbook, the vapor pressure of 10% HCL solution at 35°C is 0.0178 mmHg.

   $$P = 0.0178 mmHG \times \frac{1\ ATM}{760 mmHg} \times \frac{14.7\ psia}{1\ ATM} = 0.000344\ psia$$

3. Determine the gas-mass transfer coefficient (K) for HCL

   $$K = 0.011479 \times U^{0.78} / M^{(1/3)}$$
   $$= 0.011479 \times (1)^{0.78} / 36.461^{(1/3)} = 0.00346\ ft/sec$$

4. Determine the temperature (T_1) of the acid tank in degrees Rankin (°R)

   T_1 = 95°F + 460 = 555°R

5. Determine the amount of HCL released (W) in one hour.

   $$W(lb/hr) = \frac{36.461\ lb/lbmole \times 12ft^2 \times 0.000344 psia \times 0.00346\ ft/sec \times 3600\ sec/hr}{10.73\ (psia\ ft^3/°R\ lb\text{-}mole) \times 555°R}$$

   W(lb/hr) = 0.000315

6. Determine the amount of HCL released (W) in one year.

   To convert from pounds per hour to pounds per year, multiply by the number of hours operated in a year. For example, if a tank operated 1,200 hours per year, then:

   0.000315 lb/hr x 1,200 hrs/yr = 0.378 lbs/yr